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Adapting Methods of Student Evaluation and Grading in Electrical Power Engineering

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Abstract

Since 1990, authors' experience in the evaluation and grading of students, as evidenced by a decline of students' motivation, has been a clear reduction in the effectiveness of classical methods of evaluation and scoring. This paper presents results obtained from using software called Hotpotatoes's in the initial evaluation and grading of students in electrical power generation at the Power Engineering Department of the University Politehnica Timisoara. The Hot Potatoes package, used by the authors in evaluation and scoring, is quite diverse, Its effects on how students of electrical power engineering learn were identified by using JQuiz and Masher. The use of these modules generate packets of questionnaires. Each questionnaire represents a theory chapter, or set of applications. One advantage of JQuiz is the use of multiple forms of answers to questions. For questions aiming the fixing and verification of the theory are used two of these forms: the single correct answer from multiple choices and answer by multiple-select options to achieve the correct answer. For questions testing the ability of solving simple applications, the form used for response is to input of a character set consisting in the correct value of the result. Advantages highlighted by using this method of evaluation and grading include eliminating the subjective component of evaluation, a dense coverage of the knowledge taught with questions, less time spent evaluating and grading students, and a simpler and clearer differentiation in higher and lower performing students.

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1. Introduction

The assessment of students in contemporary higher education requires new approaches, both in terms of the quality of knowledge measurement and the volume of accumulated knowledge and of the ability to use that

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knowledge (Chowdhury, 2000). Traditional forms of knowledge assessment provides a method for assigning numerical scores. However, they, rarely reveals how students actually understand issues, reason with specific knowledge and ideas or how they apply knowledge to solving common or less common problems in domain. Indeed, it is worth mentioning that teachers can give different weights to tests, depending on their perceived importance when, in fact, the result may be significantly different from what was intended, due to a failure to account for the variation of the results from one test to another. This paper summarizes the changes in the evaluation and grading of students in a particular discipline and also assess the evolution of students' achievement and outcomes for this specialized discipline. The authors also present a proposed framework for the development and improvement of suitable evaluation tools and procedures, appropriate to specialized technical disciplines.

2. The essential knowledge needeeds in power system engineering

Engineers working with power system must realize the operation, maintenance and management of power system installations. These systems must operate to ensure the power supply is imposed at defined quality parameters, with a maximum degree of continuity to industry consumers, and to other fields of human activity. Depending on the complexity of each activity a power engineer must have knowledge of the operation and management of one or more devices or the operation of a simple or complex system in which just some equipments must operate effectively. A study programme must provide theoretical knowledge with consistent practical support to understand the optimal operation of power systems and how optimum performance can be ensured even when changes in operating conditions occur. In this respect both current regimes' management and expansion with new elements of power systems or system planning in the medium and long term evolution is based on the calculation and analysis of power flow.

A qualitative overview of what students are expected to achieve through learning is defined by:

- Memorizing definitions, equations, etc.
- Applying equations and procedures;
- An understanding of the concepts and procedures involved;
- A more complete understanding of the phenomena involved.

In addition to the transmission of knowledge and the construction of skills and competencies, it is very important to carry out an assessment of their quality. In recent years, the authors have developed a system whereby the assessment of students can be made objectively and comprehensively. This system and the results of its implementation are presented below.

3. Software tool used

The origin of this system of student assessment is essentially a questionnaire form. Certain tools in questionnaire forms for the training and examination of the Romanian transmission network are also used (Jigoria-Oprea, Simo & Borlea, 2014). For the construction of our questionnaire we used a software package that to supports learning and knowledge assessment called Hot Potatoes. The Hot Potatoes suite, Fig. 1, (Hot Potatoes, 2013) includes six applications that, enables teachers to create interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering and gap-fill exercises for the World Wide Web. Hot Potatoes is freeware, and can be used for any purpose or project.

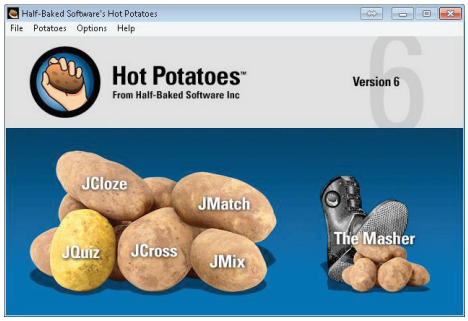

Fig. 1. Hot Potatoes suite

The JQuiz component was used, to create an effective questionnaire. This enabled the construction of sets of questions with multiple-choice type answers or short-answers. In this way questions sets were made for each chapter. Each student attempts to solve a questionnaire consisting of a random selection of questions representing a sixth of the total set of chapter questions.

The application generates files that can be opened in a web browser, one set for each chapter. Each time they are opened in a browser, a random set (at a predefined dimension) is loaded. The questionnaire is considered completed when either the correct answer is given to all questions (even after several attempts) or when the student is out of time. When the questionnaire is finished, the number of correctly answered questions is given as a percentage, which can then be converted into a grade.

4. Results of the proposed evaluation system.

The traditional way to examine the students is by writing and / or orally solving a certain number of proposed subjects, possibly accompanied by written questionnaires. This method of examination, suffers at least in terms of the volume of knowledge covered, and even an inevitable dose of bias in correction. For this reason the authors have proposed a combined verification system consisting partly of a questionnaire, done on computer, and some traditional written major subjects. The element of originality is represented by the diversified questionnaire realized by the authors on computer and also passed by the students through completion on a computer. The questionnaire is made from several types of questions. These are divided into chapters, and are in sufficient number of questions to constitute a large basis to be randomly selected in a number of questions for each student. In our particular case there was whole set of 250 questions from which a student must answer 30 questions (proportional to the number of questions in each chapter) in a limited time. The questions are divided into topics concerning theoretical aspects and small specific problems. In this way knowledge of the discipline is fully covered.

The authors have assessed students by this method for 12 years. Following analysis of the results the evolution of average and median grades are given in Table 1.

Table 1. Evolution of students grades.

Year	1	2	3	4	5	6	7	8	9	10	11	12
Average	6.0	6.2	5.4	5.4	6.2	5.4	6.0	5.4	5.8	6.1	5.5	6.5
Median	5.5	5.6	5.2	5.3	6.1	5.3	6.0	5.1	5.5	5.9	5.1	6.4

As seen in Table 1, variations occur from one year to another, both for the average and the median value, and with some natural variations from one generation to other.

The evolution of student marks, plotted by the mean and the median, is shown in Fig. 2 below. This trend shows a slightly increasing trend of the notes, which (knowing also the fact that the level of general instruction of students

is decreasing (The Canadian Electricity Association, 2005) highlights the positive influence of proposed evaluation system.

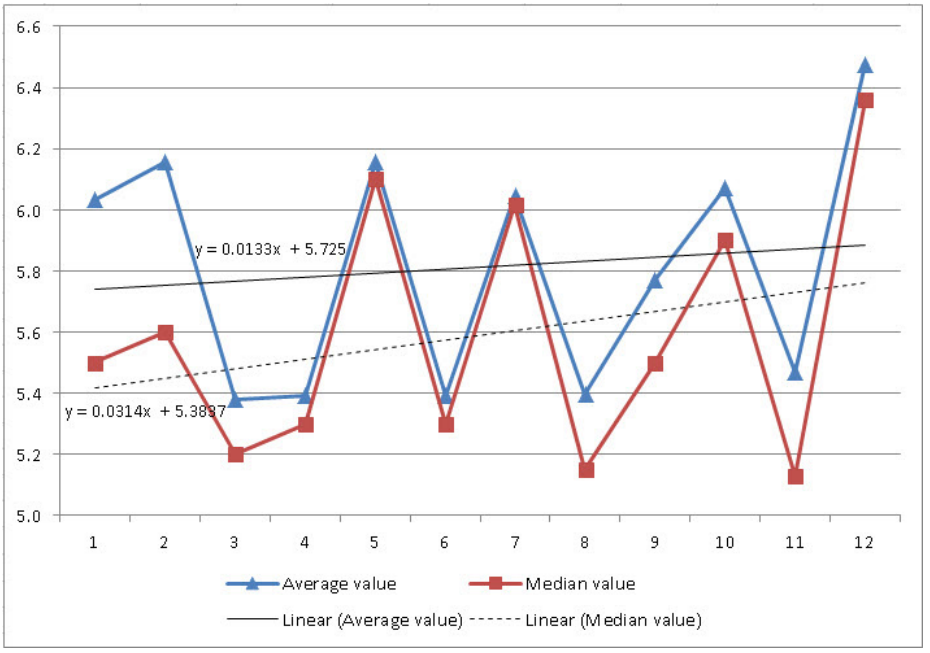

Fig. 2. Evolution of students grades - trends superimposed

In order to make a more objective assessment of student performance and their ranking in terms of normality, it was considered helpful to use the Gauss distribution, according to ECTS (European Credit Transfer System) with the following grades:

- A (excellent), 10% of students;
- B (very good), 25% of students;
- C (good), 30% of students;
- D (satisfactory), 25% of students;
- E (sufficient), 10% of students.

The results reflected in this classification are shown in Table 2.

Table 2. Evolution of students ECTS grades.

Year	1	2	3	4	5	6	7	8	9	10	11	12
A	4	2	1	1	4	4	5	6	5	4	6	7
B	13	10	13	7	17	8	13	15	14	10	16	15
C	14	14	19	15	22	11	13	17	14	10	17	17
D	26	13	0	6	18	6	14	15	14	10	16	16
F	6	7	19	9	7	9	5	6	5	4	6	6

The trends highlighted by Fig. 2 are also valid for Fig. 3. However, ECTS classification reveals an increase in the proportion of students with the highest grade (see the trend for A grade) and a decrease in students with the lowest grade (see the trend for E grade).

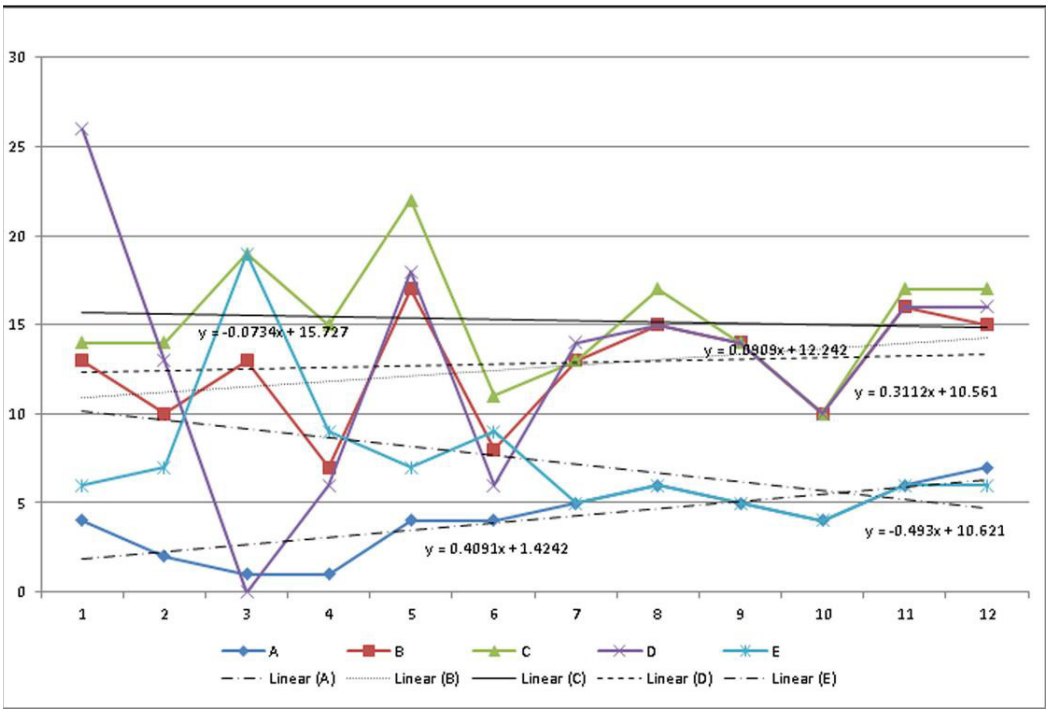

Fig. 3. Evolution of students ECTS grades - trends superimposed

Further advantages of this method of evaluation and grading include eliminating the subjective component of evaluation, more dense coverage of the knowledge taught a reduced time spent by examiners in evaluating and grading students, and a simpler and clearer differentiation between higher and lower performing students.

5. Conclusion

This paper presents the experience of 12 years' use of a new method in evaluating students. The authors have imagined a combined verification system consisting partly of a questionnaire, done on computer, and traditional written major subjects. The element of originality is represented by the diversified questionnaire realized by the authors on computer and also passed by the students through completion on a computer. Results from a quantitative criteria analysis, based on students' grades, suggest the new evaluation system helps and motivates students to achieve a better level of preparation (especially for those at the top level). The new evaluation system also leads to other students to at least maintain their grades. Further advantages of this system include eliminating the subjective component of evaluation, a more dense coverage of the knowledge taught with questions, a reduced time spent in the evaluation and grading of students for examiners, and a simpler and clearer differentiation between higher and lower performing students.

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